Progress and prospects for stem cell engineering.

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Public Summary:
Stem cells offer tremendous biomedical potential owing to their abilities to self-renew and differentiate into cell types of multiple adult tissues. Researchers and engineers have increasingly developed novel discovery technologies, theoretical approaches, and cell culture systems to investigate microenvironmental cues and cellular signaling events that control stem cell fate. This review discusses the ways in which miniaturization, mathematical modeling and engineered tissue culture microenvironments may contribute to the development of stem cell technologies and stem cell-based therapeutics.

Scientific Abstract:
Stem cells offer tremendous biomedical potential owing to their abilities to self-renew and differentiate into cell types of multiple adult tissues. Researchers and engineers have increasingly developed novel discovery technologies, theoretical approaches, and cell culture systems to investigate microenvironmental cues and cellular signaling events that control stem cell fate. Many of these technologies facilitate high-throughput investigation of microenvironmental signals and the intracellular signaling networks and machinery processing those signals into cell fate decisions. As our aggregate empirical knowledge of stem cell regulation grows, theoretical modeling with systems and computational biology methods has and will continue to be important for developing our ability to analyze and extract important conceptual features of stem cell regulation from complex data. Based on this body of knowledge, stem cell engineers will continue to develop technologies that predictably control stem cell fate with the ultimate goal of being able to accurately and economically scale up these systems for clinical-grade production of stem cell therapeutics.